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Batchvarova, Ekaterina; Gryning, Sven-Erik

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Marine wind profiles measured by a wind-lidar – ability of WRF predict marine wind profiles

Ekaterina Batchvarova (1) and Sven-Erik Gryning (2)

(1) National Institute of Meteorology and Hydrology, Sofia, Bulgaria (ekaterina.batchvarova@meteo.bg), (2) DTU Wind Energy, Technical University of Denmark, Roskilde, Denmark (sveg@dtu.dk)

Observations by wind lidars are becoming increasingly common in connection with wind energy assessment studies and operation of wind farms. Wind lidars today are often replacing tall meteorological masts. The quality of the individual wind-lidar observations is described by the so-called Carrier to Noise Ratio (CNR).

One year of marine wind observations are compared to WRF simulations up to an altitude of 600 m. the comparison was carried out for threshold values $\text{CNR} > -22$ dB and -35 dB respectively. In both cases it was found that up to 100 m there was generally good agreement between the WRF predictions and the observations. Above 100 the WRF simulated wind speeds were smaller than the observations and in such a way that the difference increases with increasing wind speed – represented by the 25, 50 and 75% quantiles.

It is demonstrated that by filtering the wind-lidar observations with a CNR threshold value has consequences for the measured long-term wind speed. Use of wind measurements with a low values of the CNR (e. g. -22 dB) leads to an over-prediction of the wind speed as compared to filtering the data with a $\text{CNR} = -35$ dB. The effect is seen for all wind speed represented in this study by their 25, 50 and 75% quantiles.

In conclusion:

It is important to consider the CNR effect on mean wind speed when using a wind-lidar for climatological studies. In an example of marine climatology from FINO₃, WRF underpredicts the 25%, 50% and 75% per centile of the wind speed profile up to 600 m applying filtering with $\text{CNR} > -22$ dB on the wind lidar measurements.